CLAIMS

What is claimed is:

1. A polymer electrolyte fuel cell comprising:

a membrane electrode assembly forming a cell comprising a hydrogen-ion conductive polymer electrolyte membrane and an anode and a cathode sandwiching said polymer electrolyte membrane;

an anode-side separator plate having a pair of fuel gas manifold apertures, a pair of oxidant gas manifold apertures, and a fuel gas flow channel connected to said pair of fuel gas manifold apertures for supplying and discharging a fuel gas to and from the anode;

a cathode-side separator plate having a pair of fuel gas manifold apertures, a pair of oxidant gas manifold apertures, and an oxidant gas flow channel connected to said pair of oxidant gas manifold apertures for supplying and discharging an oxidant gas to and from the cathode;

an anode-side sealing member provided on the anode-side surface of said anode-side separator plate; and

a cathode-side sealing member provided on the cathode-side surface of said cathode-side separator plate,

said membrane electrode assembly being sandwiched under pressure between said anode-side and cathode-side separator plates to form said cell,

wherein said anode-side sealing member and said cathode-side sealing member seal the cell, in cooperation with the polymer

electrolyte membrane, at sealing parts where the anode-side and cathode-side sealing members are opposed to each other, to prevent the fuel gas and the oxidant gas from leaking out of said fuel gas flow channel and said oxidant gas flow channel, and

wherein one of said sealing members has a pointed rib that contacts said sealing parts in a linear manner, and the other of said sealing members contacts said sealing parts surface-to-surface.

2. The polymer electrolyte fuel cell in accordance with claim 1, wherein:

said polymer electrolyte membrane has a pair of fuel gas manifold apertures and a pair of oxidant gas manifold apertures,

said anode-side sealing member has a first anode-side sealing section that surrounds the anode and the fuel and oxidant gas manifold apertures to form a closed loop and a second anode-side sealing section that separates the anode from the oxidant gas manifold apertures,

said cathode-side sealing member has a first cathode-side sealing section that surrounds the cathode and the fuel and oxidant gas manifold apertures to form a closed loop and a second cathode-side sealing section that separates the cathode from the fuel gas manifold apertures, and

said anode-side and cathode-side sealing members are sandwiched between said anode-side and cathode-side separator

plates and pressed against the polymer electrolyte membrane, in such a manner that said pointed rib comes in contact with the polymer electrolyte membrane in a linear manner and the other sealing member comes in contact with the polymer electrolyte membrane surface to surface.

3. The polymer electrolyte fuel cell in accordance with claim 2, wherein:

said second anode-side sealing section separates the anode from both the fuel and oxidant gas manifold apertures; and

said second cathode-side sealing section separates the cathode from both the fuel and oxidant gas manifold apertures.

4. The polymer electrolyte fuel cell in accordance with claim 1, wherein:

said polymer electrolyte membrane is large enough to cover the anode and the cathode but not so large as to cover any part of said fuel and oxidant gas manifold apertures,

said anode-side sealing member has a first anode-side sealing section that surrounds the anode and the fuel gas manifold apertures to form a closed loop and a second anode-side sealing section that surrounds said polymer electrolyte membrane in combination with said first anode-side sealing section, said first anode-side sealing section being in contact with said polymer electrolyte membrane at the anode surrounding part,

said cathode-side sealing member has a first cathode-side sealing section that surrounds the cathode and the oxidant gas manifold apertures to form a closed loop and a second cathode-side sealing section that surrounds said polymer electrolyte membrane in combination with said first cathode-side sealing section, said first cathode-side sealing section being in contact with said polymer electrolyte membrane at the cathode surrounding part,

said anode-side and cathode-side sealing sections correspond in position except unavoidable parts, and said anode-side and cathode-side sealing members are sandwiched between said anode-side and cathode-side separator plates and pressed against each other or the polymer electrolyte membrane at the respective sealing sections, and

at the pressed parts, the pointed rib comes in contact with said polymer electrolyte membrane or the other sealing member in a linear manner, and the other sealing member comes in contact with said polymer electrolyte membrane or said one of the sealing members surface to surface.

5. The polymer electrolyte fuel cell in accordance with claim 4, wherein said one of the sealing members is so configured that the height of the rib at the part of the first sealing section not in contact with said polymer electrolyte membrane and the height of the rib at the second sealing section are greater

than the height of the rib at the part of the first sealing section in contact with said polymer electrolyte membrane.

6. The polymer electrolyte fuel cell in accordance with claim 1, wherein the rib of said one of the sealing members is, at the anode or cathode surrounding part, shaped like a wedge of which cross section is thin on the inner side and thick on the outer side.

7. The polymer electrolyte fuel cell in accordance with claim 6, wherein:

the cathode-side sealing member comprises: (a) a first part that surrounds said oxidant gas flow channel and said pair of oxidant gas manifold apertures to form a closed loop; (b) a pair of second parts that surround each of said pair of fuel gas manifold apertures to form closed loops; and (c) third parts that connect the first part with the second part, and

the first part is shaped like a wedge of which cross section is thin on the inner side and thick on the outer side, and the second parts are shaped like a wedge of which cross section is thick on the inner side and thin on the outer side.

8. The polymer electrolyte fuel cell in accordance with claim 1, wherein said anode-side and cathode-side sealing members have a three-layered structure of a resin film, an adhesive layer

formed on a separator side of said resin film, and a rubber layer formed on a face of said resin film opposite to said adhesive layer.

9. The polymer electrolyte fuel cell in accordance with claim 1, wherein the ratio of pressure loss Pc in the clearance between the electrode and the sealing member to pressure loss Pf in the gas flow channel adjacent to the electrode is greater than 0.9.

10. The polymer electrolyte fuel cell in accordance with claim 6, wherein one-side clearance cl between said cathode and said cathode surrounding part of said cathode-side sealing member and a hydraulic diameter d of the clearance cl satisfy the formula: $d < (D \times l \times P)/0.54L$,

wherein l is the length of the clearance cl, L is the length of the oxidant gas flow channel per one path of the cathode-side separator plate, D is the hydraulic diameter of the oxidant gas flow channel per one path of the cathode-side separator plate, P is the number of paths of the oxidant gas flow channel of the cathode-side separator plate, and the hydraulic diameter d = (cross section of the clearance) ÷ (peripheral length of the cross section) × 4.

11. The polymer electrolyte fuel cell in accordance with claim 10, wherein the one-side clearance cl satisfies the formula: 0.25 mm < cl.

12. The polymer electrolyte fuel cell in accordance with claim 1, wherein at least one of the anode-side and cathode separator plates has a main surface covered with the corresponding sealing member.

13. The polymer electrolyte fuel cell in accordance with claim 1, wherein at least one of the anode-side and cathode-side sealing members is molded on the corresponding separator plate.

14. The polymer electrolyte fuel cell in accordance with claim 1, wherein at least one of the anode-side and cathode-side sealing members is fitted to the corresponding separator plate.

15. The polymer electrolyte fuel cell in accordance with claim 1, wherein at least one of the anode-side and cathode-side sealing members is bonded to the corresponding separator plate.

16. The polymer electrolyte fuel cell of claim 1, wherein the pair of anode-side and cathode-side sealing members comprises:

anode-side and cathode-side electrode sealing parts that sandwich the polymer electrolyte membrane around the anode and the cathode;

anode-side and cathode-side manifold aperture sealing parts that sandwich the polymer electrolyte membrane around the anode-side and cathode-side fuel gas manifold apertures and the anode-side and cathode-side oxidant gas manifold apertures; and

anode-side and cathode-side connection groove sealing parts that sandwich the polymer electrolyte membrane on both sides of respective connection grooves connecting the fuel gas flow channel to the anode-side fuel gas manifold apertures and connecting the oxidant gas flow channel to the cathode-side oxidant gas manifold apertures.

17. The polymer electrolyte fuel cell of claim 16, wherein the anode-side sealing member separates:

the anode-side fuel gas manifold apertures from the anode, with the anode-side manifold aperture sealing part and the anode-side electrode sealing part, which surrounds the anode; and

the anode-side oxidant gas manifold apertures from the anode, with the anode-side manifold aperture sealing part and the anode-side electrode sealing part.

18. The polymer electrolyte fuel cell of claim 16, wherein the anode-side sealing member separates the anode-side fuel gas

and oxidant gas manifold apertures from the anode with the anode-side manifold aperture sealing part.

19. The polymer electrolyte fuel cell of claim 16, wherein the anode-side sealing member separates the anode-side fuel gas and oxidant gas manifold apertures from the anode with the anode-side electrode sealing part, which surrounds the anode.

20. The polymer electrolyte fuel cell of claim 16, wherein the cathode-side sealing member covers the whole main surface of the cathode-side separator plate, including the cathode-side electrode sealing part, the cathode-side manifold aperture sealing part, and the cathode-side connection groove sealing part.

21. The polymer electrolyte fuel cell of claim 16, wherein the cathode-side sealing member is approximately the same size as the anode-side sealing member.

22. The polymer electrolyte fuel cell of claim 16, wherein the anode-side sealing member comprises a first anode-side sealing section that surrounds the fuel gas flow channel and the pair of anode-side fuel gas manifold apertures to form a closed loop.

23. The polymer electrolyte fuel cell of claim 22, wherein the anode-side and cathode-side manifold aperture sealing parts each comprises:

anode-side oxidant gas manifold aperture sealing parts that surround the anode-side oxidant gas manifold apertures;

anode-side cooling water manifold aperture sealing parts that surround a pair of anode-side cooling water manifold apertures; and

anode-side spare manifold aperture sealing parts that surround a pair of anode-side spare manifold apertures.

24. The polymer electrolyte fuel cell of claim 23, wherein the first anode-side sealing section comprises:

the anode-side electrode sealing part, which surrounds the fuel gas flow channel;

anode-side fuel gas ones of the anode-side manifold aperture sealing parts that surround the outer half of the anode-side fuel gas manifold apertures; and

the anode-side connection groove sealing parts located on both sides of the anode-side connection grooves.

25. The polymer electrolyte fuel cell of claim 24, wherein the anode-side sealing member comprises first, second, third, and fourth sealing parts, wherein:

the first sealing parts connect the anode-side fuel gas manifold aperture sealing parts with the anode-side oxidant gas manifold aperture sealing parts;

the second sealing parts connect the anode-side fuel gas manifold aperture sealing parts with the anode-side cooling water manifold aperture sealing parts;

the third sealing parts connect the anode-side oxidant gas manifold aperture sealing parts with the anode-side spare manifold aperture sealing parts; and

the fourth sealing parts connect the anode-side cooling water manifold aperture sealing parts with the anode-side spare manifold aperture sealing parts.

26. The polymer electrolyte fuel cell of claim 24, wherein:

the anode-side sealing member comprises a second anode-side sealing section that forms a closed loop in combination with the anode-side fuel gas manifold aperture sealing parts of the first anode-side sealing section; and

the anode-side oxidant gas, cooling water, and spare manifold apertures are located outside the closed loop.

27. The polymer electrolyte fuel cell of claim 1, wherein the cathode-side sealing member has a flat surface on a major planar side facing the anode-side separator plate and is mounted along a sealing member groove of the cathode-side separator

plate, which sealing member groove receives the cathode-side sealing member.

28. The polymer electrolyte fuel cell of claim 1, wherein the cathode-side sealing member comprises a first cathode-side sealing section that surrounds the oxidant gas flow channel and the pair of cathode-side oxidant gas manifold apertures to form a closed loop.

29. The polymer electrolyte fuel cell of claim 28, wherein the cathode-side sealing member further comprises:

cathode-side fuel gas manifold aperture sealing parts that surround the cathode-side fuel gas manifold apertures;

cathode-side cooling water manifold aperture sealing parts that surround a pair of cathode-side cooling water manifold apertures;

cathode-side spare manifold aperture sealing parts that surround a pair of cathode-side spare manifold apertures; and

first cathode-side sealing parts located on both sides of each of a plurality of connection grooves of the anode-side separator plate, which connection grooves connect the anode-side fuel gas manifold apertures to the fuel gas flow channel.

30. The polymer electrolyte fuel cell of claim 29, wherein the first cathode-side sealing section comprises:

a cathode-side electrode sealing part that surrounds the oxidant gas flow channel; and

cathode-side oxidant gas manifold aperture sealing parts surrounding the outer half of the cathode-side oxidant gas manifold apertures, wherein:

the cathode-side sealing parts are located on both sides of each of a plurality of cathode-side connection grooves that connect the cathode-side oxidant gas manifold apertures to the oxidant gas flow channel.

31. The polymer electrolyte fuel cell of claim 30, wherein the cathode-side sealing member further comprises first, second, third, and fourth sealing parts, wherein:

the first sealing parts connect the cathode-side fuel gas manifold aperture sealing parts with the cathode-side oxidant gas manifold aperture sealing parts;

the second sealing parts connect the cathode-side fuel gas manifold aperture sealing parts with the cathode-side cooling water manifold aperture sealing parts;

the third sealing parts connect the cathode-side oxidant gas manifold aperture sealing parts with the cathode-side spare manifold aperture sealing parts; and

the fourth sealing parts connect the cathode-side cooling water manifold aperture sealing parts with the cathode-side spare manifold aperture sealing parts.

32. The polymer electrolyte fuel cell of claim 30, wherein a second cathode-side sealing section comprises:

cathode-side manifold aperture sealing parts; and

second cathode-side sealing parts connecting the cathode-side manifold aperture sealing parts, wherein:

the second sealing section forms a closed loop in combination with the cathode-side oxidant gas manifold aperture sealing parts of the first cathode-side sealing section, and

the cathode-side fuel gas, cooling water, and spare manifold apertures are located outside the closed loop.

33. The polymer electrolyte fuel cell of claim 5, wherein the height of the rib at the part of the first sealing section that is in contact with the polymer electrolyte membrane is greater than the height of the rib at the part of the first sealing section not in contact with the polymer electrolyte membrane by approximately the thickness of the polymer electrolyte membrane or more.